

WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

**Presentation of the
Stormwater Manual for
Western Washington to the
Independent Science Panel**



Purpose & Agenda

Purpose

- Clarify the Context and Content

Agenda

- Background
- Overview of Manual
- Rationale for Thresholds, Flow Control, Treatment
- Limitations of Manual
- Respond to Questions
- Access to More information

Objective of the Manual

- Protect aquatic natural resources by
- Providing a commonly accepted set of standards and technical guidance for
- Improving the quality & and controlling the flow rate of runoff from new development and redevelopment



Why Revise the Manual?

- Technical Update of 1992 Manual
- Protect aquatic natural resources
- Comply with federal stormwater rule to publish guidance
- Expand scope to Western Washington



What the Stormwater Manual is...

- A link between the legal requirement to properly manage stormwater and the science and research which shows the impacts of improperly managed stormwater





Federal and State Laws

- **Federal Clean Water Act & State Water Pollution Control Act**
 - Technology-based requirement
 - Water quality-based requirement
- **Endangered Species Act**
- **Other**
 - Safe Drinking Water Act
 - Hydraulic Code

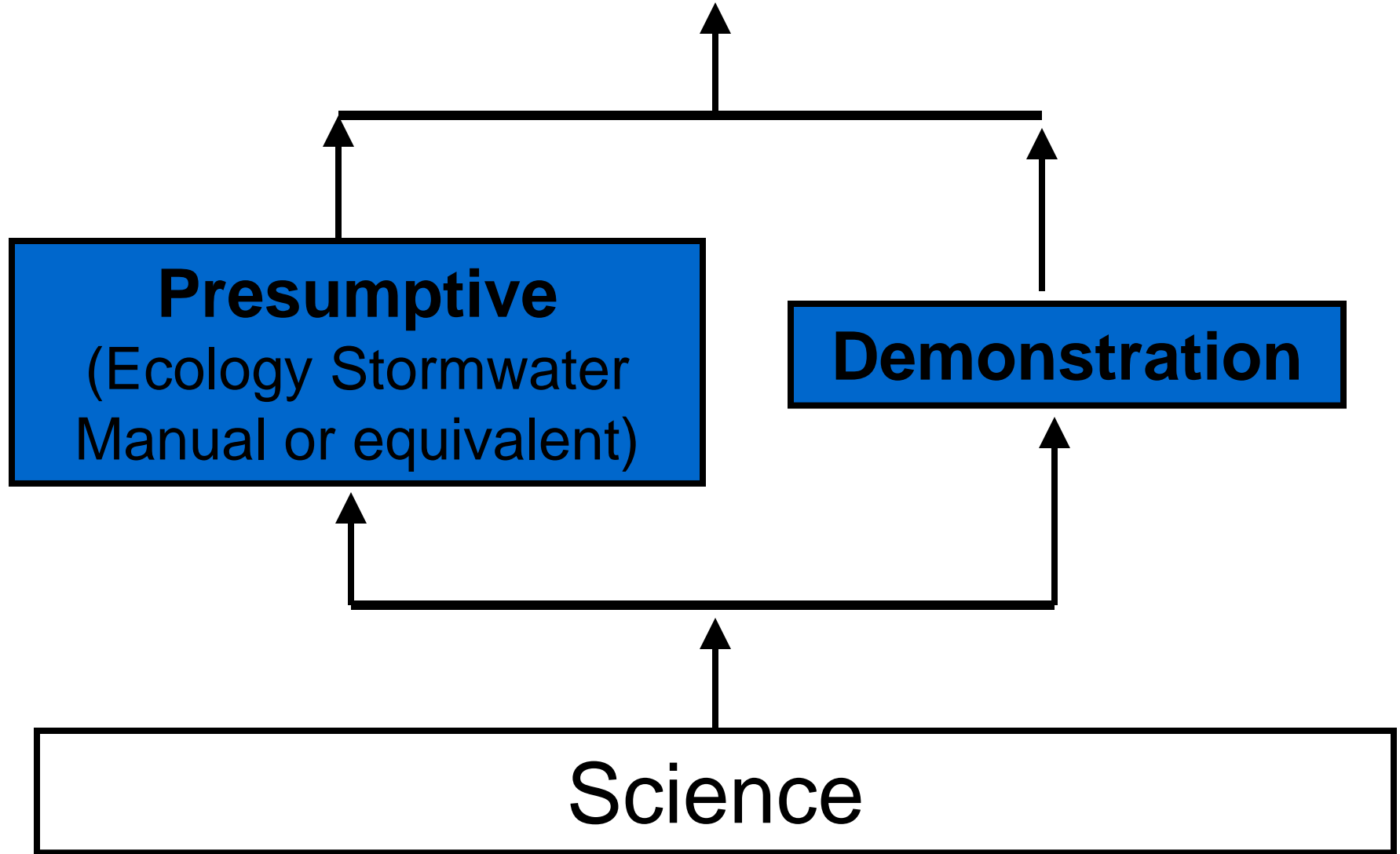
Federal and State Law

Presumptive

(Ecology Stormwater
Manual or equivalent)

Demonstration

Science



Regulatory Status

- **Guidance:**
 - No Independent Authority
 - Not a Rule
- **Requirement through existing regulatory mechanisms**
 - Permits, authorizations



How did Ecology Revise the Manual?

- **Technical Advisory Committees (TACs)**
 - TAC for each volume - > 70 members
- **Public Outreach on 2 Drafts**
 - 2 rounds of Public Workshops
 - Meetings with Stakeholder Groups
 - Press Releases, articles, Ecology Web-page
- **Review by National Experts – Volume V**
- **Technical Editing Consultant**



The Manual Consist of 5 Volumes:



- I. Minimum Technical Requirements & Site Planning**
- II. Construction Stormwater Pollution Prevention**
- III. Hydrologic Analysis and Flow Control Design/BMPs**
- IV. Source Control BMPs**
- V. Runoff Treatment BMPs**



VOLUME I

Minimum Technical Requirements & Site Planning

Volume I



- Chapter 1 – Introduction
- Chapter 2 – Minimum Requirements
- Chapter 3 – Preparation of Stormwater Site Plans
- Chapter 4 – BMP & Facility Selection Process
- Appendices & Glossary

Chapter 2

Minimum Requirements

For New Development &
Redevelopment



Section 2.2 - Exemptions



- **Forestry & Commercial Agriculture**
 - Conversion to Ag. Land & Impervious Surface Construction not exempt
- **Road Maintenance**
 - Remove to base course, extend pavement edge, paving shoulder, surface upgrades not exempt
- **Underground Utility Projects**
 - Replace surface with in-kind = exempt except Erosion Control

Section 2.3 - Definitions



- **Effective Impervious Surface**
- **Pollution-Generating Impervious Surface (PGIS)**
- **Pollution-Generating Pervious Surface (PGPS)**
- **Land Disturbing Activity**
- **Threshold Discharge Area**

Minimum Requirements

Section 2.5



1. Preparation of Stormwater Site Plans
2. Construction Stormwater Pollution Prevention
3. Source Control of Pollution
4. Preservation of Natural Drainage Systems and Outfalls
5. Onsite Stormwater Management

Minimum Requirements



6. Runoff Treatment

7. Flow Control

8. Wetlands Protection

9. Basin/Watershed Planning

10. Operation and Maintenance

Section 2.4 - Project Thresholds



- Who needs to do what?
- Depends upon size of the project
 - Amount of impervious surface
 - Extent of land disturbed

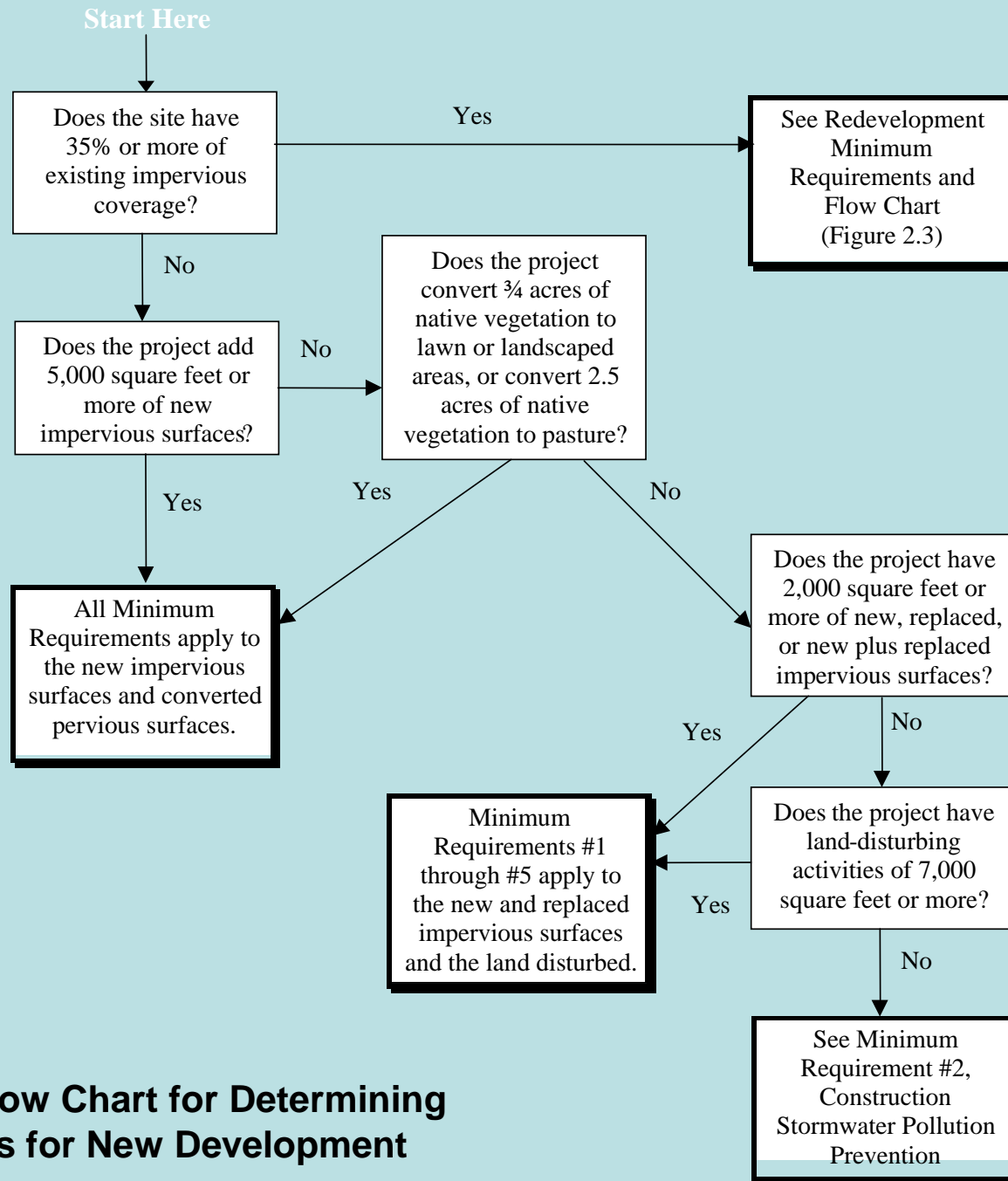


Figure 2.2 Flow Chart for Determining Requirements for New Development

New Development Thresholds



- ❑ **Min. Req. #2 -Erosion control**
 - ⇒ all projects regardless of size

- ❑ **Basis**

- ⇒ Every land disturbance should take action to minimize erosion
- ⇒ Local permitting not required; handout information with building or other permit

New Development Thresholds

□ Min. Requirements #1 - #5:

- ⇒ 2,000 sq. ft. impervious area, or 7,000 sq. ft. land disturbance

□ Basis

- ⇒ Capture most single family residences and equivalent commercial
- ⇒ Cumulative impact of individual homes can cause significant impacts
(See Booth & Jackson, 1997, p. 16)
- ⇒ Origin: Stormwater Managers proposal in Tri-County 4(d) Proposal



New Development Thresholds

□ Min. Requirements #1 - #10:

- ⇒ 5,000 sq. ft. new impervious area, or
- ⇒ 3/4 acre native vegetation to lawn/landscape, or
- ⇒ 2.5 acres native vegetation to pasture

□ Basis

- ⇒ 5,000 sq. ft. from 1977 manual for King/Snohomish Co.'s; 1992 manual holdover
- ⇒ reasonable size for expectation to operate and maintain treatment facilities (See Kulzer, 1994)
- ⇒ 3/4 acre and 2.5 acre conversions correspond to 0.1 cfs increase in 100-year flow. 1/2-inch orifice minimum size for frequent plugging avoidance



Minimum Requirement #6

Runoff Treatment



- Thresholds
- Facility Sizing
- Level of Treatment
- Design
- Maintenance

Runoff Treatment Thresholds

Table 2.1 Treatment Requirements by Threshold Discharge Area

	< $\frac{3}{4}$ acres of PGPS	$\geq \frac{3}{4}$ acres PGPS	< 5,000 sf PGIS	$\geq 5,000$ sf PGIS
Treatment Facilities		✓		✓
Onsite Stormwater BMPs	✓	✓	✓	✓

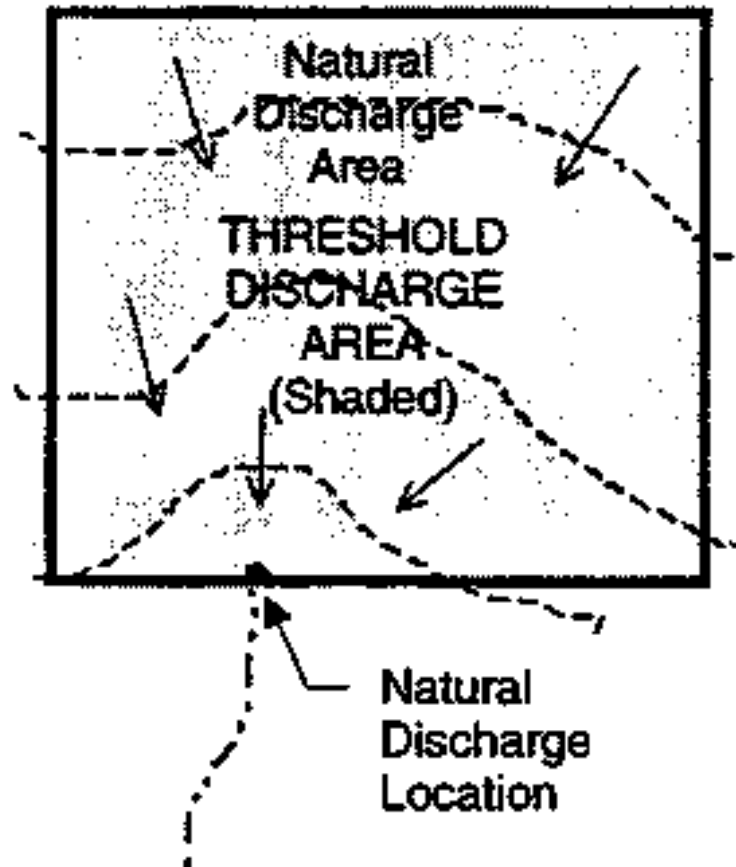
PGPS = pollution-generating pervious surfaces

PGIS = pollution-generating impervious surfaces

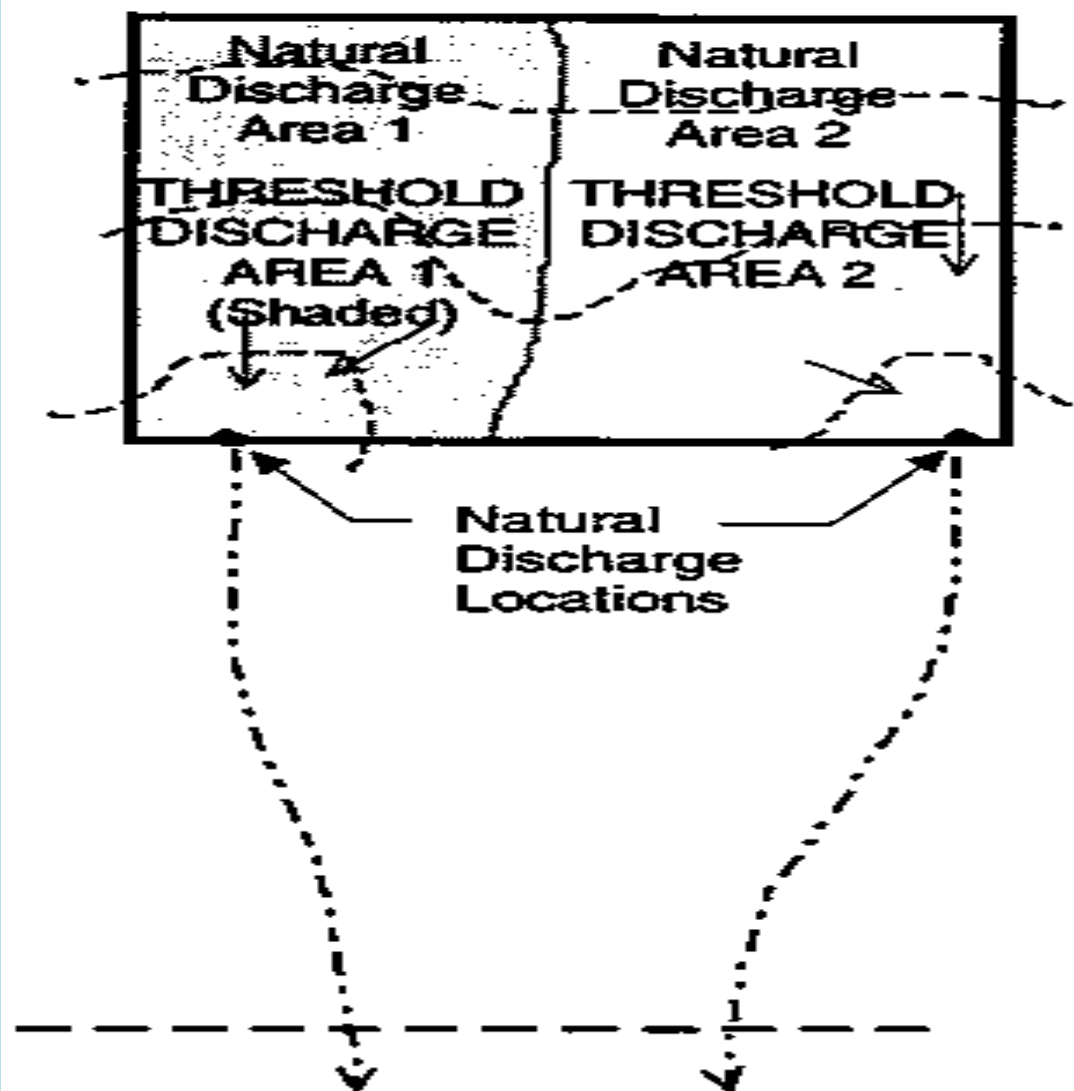
sf = square feet



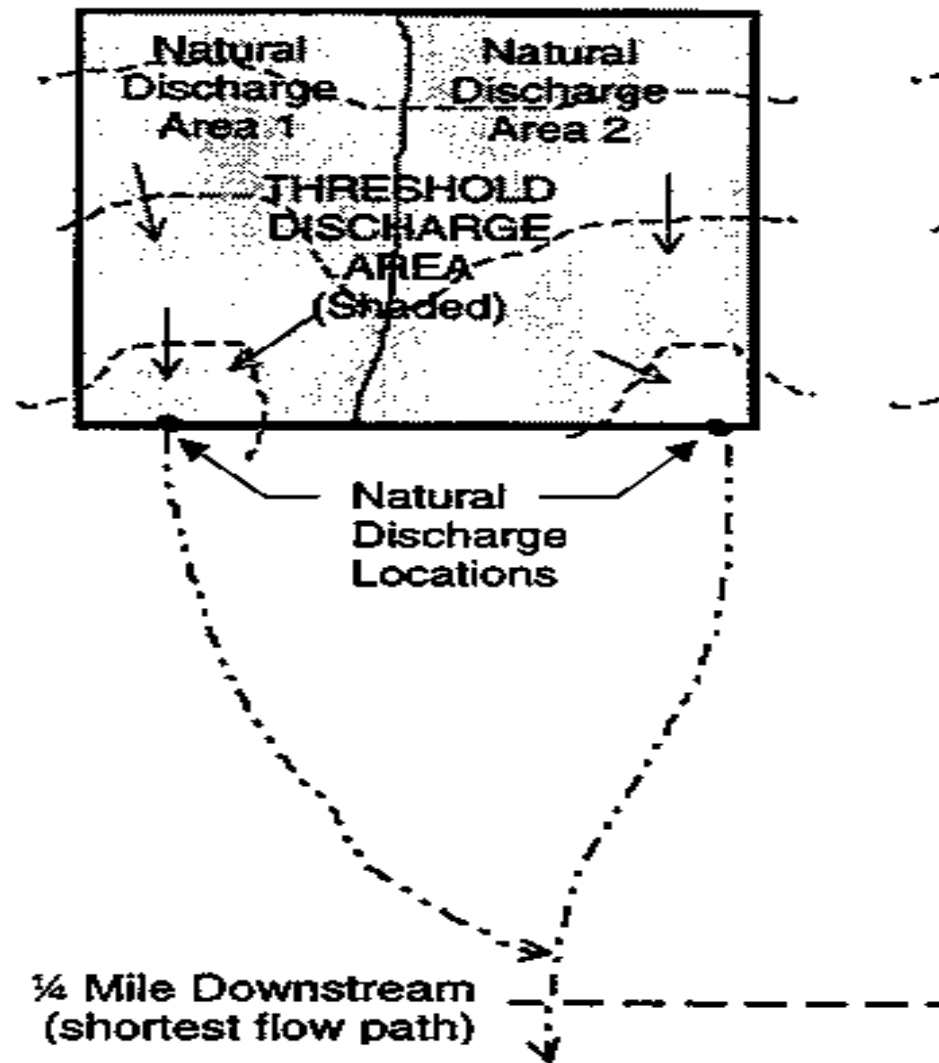
**Example of a Project Site
with a Single Natural
Discharge and a Single
Threshold Discharge Area**



**Example of a Project Site
with Multiple Natural
Discharges and Multiple
Threshold Discharge Areas**



**Example of a Project Site
with Multiple Natural
Discharges and a Single
Threshold Discharge Area**



Minimum Requirement #6

Runoff Treatment

- **Threshold Discharge Area**
 - To prevent application of engineered facilities to small areas of large projects
 - To allow small areas of larger projects to maintain their natural drainage location; don't pump!
 - To prevent drainage games to circumvent intent of guidance



Minimum Requirement #6

Runoff Treatment



- **Pollution-Generating Impervious Surfaces**
 - Significant sources of pollutants in treatable concentrations
 - Vehicular traffic
 - Industrial activities
 - Storage of erodible or leachable materials, wastes, chemicals
 - Excluded: Most res. & comm. roofs; sidewalks
- **Basis**
 - Kulzer, 1994; Pitt & Bissonette 1984
 - Watershed Protection Techniques, Vol. 1, Nos. 1 & 2; Vol. 3, No. 1; Claytor & Schueler, 1996.

Minimum Requirement #6

Runoff Treatment



- **Pollution-Generating Pervious Surfaces**
 - Significant sources of pollutants in treatable concentrations
 - Use of pesticides, fertilizers, loss of soil
 - Lawns, landscaping, golf, parks, sports
 - Excluded: Natural areas; areas w/o chemicals
- **Basis**
 - Same as PGIS

Treatment Facility Sizing

- Target: Treat 91% of annual runoff
 - 1992 manual holdover
 - Basic Cost-Effective Analysis
 - Incremental cost of pond size per cubic foot of volume treated
 - Herrera Cost Analysis - 1993
- Other States
- See Appendix B, Volume 1



Sizing Volume-Based Treatment Facilities

- **Water Quality Design Storm**
 - 6-month, 24-hour event
 - 88th to 93rd percentile, 24-hr event
 - New Estimate: 72% of 2-year, 24-hour (11% increase)
- **Size Used by Others**
 - King Co. uses 3x Mean Annual Storm (slightly smaller)
- **Applies to Wetpool Facilities**
 - Wet Ponds, Wet Vaults, Wetlands, Combined Detention/Wetpool



Sizing Flow Rate-Based Treatment Facilities

- **Water Quality Design Flow Rate**
 - **Preceding Detention/No Detention**
 - Flow Rate at or below which 91% of the runoff volume will be treated
 - Use w/ hydraulic loading design criteria
 - Need continuous runoff model
 - **Downstream of Detention**
 - The 2-year release rate from detention
 - Facilities smaller but estimates are 95 – 98% of runoff treated



Sizing Flow Rate-Based Treatment Facilities

- **Off-line**

- 91% of annual volume passes thru at WQ flow rate or less.
- 9% bypasses untreated
- WQ flow rate = 72nd to 79th percentile rate

- **On-line**

- All flows through the facility
- 9% of annual volume passes thru at higher rates than WQ design rate
- WQ flow rate = 91st percentile rate



Treatment Levels

Vol. V, Chapter 3



- Basic Treatment
- Enhanced Treatment
- Phosphorus Treatment
- Oil Control
- Each Level has a Menu of BMPs
 - Volume V, Ch. 4



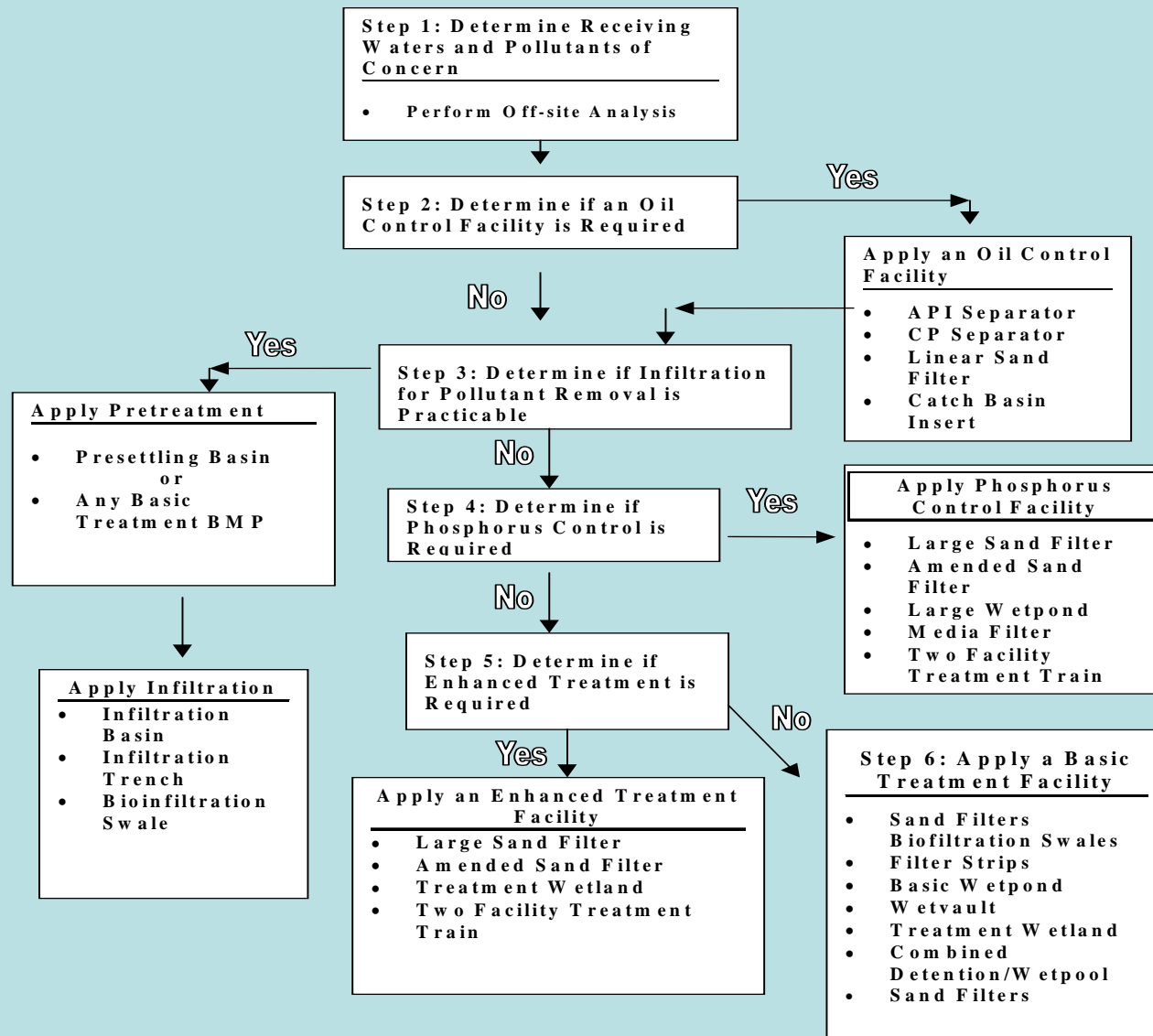
Treatment Levels

- Intent: Meet federal & state laws
- Basic & Oil Control Treatment = Presumptive; technology-based
- Phosphorus/Enhanced = Presumptive; water quality-based
- Adjustment of Presumptive Requirements through case-by-case or watershed analysis



Treatment Facility Selection

Figure 1.1 Treatment Facility Selection Flow Chart



Oil Control

- **Performance Goal: (Not Effluent Limits!)**
 - No ongoing, recurring visible sheen
 - TPH \leq 10 mg/l daily average; \leq 15 mg/l peak
- **4 BMP Options**



Oil Control



- **Applies to High-Use Sites (Source: King County)**
 - High rates of parking or stopping
 - Frequent oil transfer
- **Not Stand Alone BMPs**
 - upstream of other BMPs

Phosphorus Treatment

- Phosphorus sensitive watersheds
 - local designation or acceptance in a Water Clean-up Plan (TMDL)
- Performance Goal: 50% total P
 - WQ Design Volume/Flow Rate
- Options - 5 BMPs; 7 BMP trains



Basic Treatment

- **Performance Goal:**
 - 80% TSS removal, or
 - 20 mg/l TSS if influent < 100 mg/l
 - Applies to WQ design volume/flow rate
 - Applies on Annual Average basis, including bypass
- **Nationwide performance data and federal Nonpoint program goals**
 - Goal is suspect
 - Performance data are scattered



Basic Treatment

- 8 BMP Options listed
 - Upgrade of '92 manual
 - Typical BMP's used nationwide
 - BMP design criteria vary across nation



Basic Treatment



- Discharges to ground, unless soil criteria met
- Residential projects not in Phosphorus area
- Projects to large waters
 - Use Appendix I-C
- Projects not to fish-bearing waters or tributary

Enhanced Treatment



- **Key Question – Can we presume that use of basic treatment BMPs will comply with WQ standards and protect the resources?**
- **Basis**
 - **Nationwide & PNW stormwater runoff data**
 - **Available data on BMP removal of dissolved metals**
 - **Water Quality Standards for Copper & Zinc**
 - **Acute Criteria: 1-hour concentration, not to exceed > 1x per 3 yrs**
 - **Chronic Criteria: 4-day average, not to exceed > 1x per 3 yrs**

Factor by Which Dissolved Copper Acute WQ Standards Are Exceeded in Untreated Runoff



Hardness	20	50	75
Commercial	5.4x	2.2x	1.5x
Industrial	4.6x	1.9x	1.3x
Residential	2.4x	1x	0.7x
Transportation	4.6x	1.9x	1.3x

Enhanced Treatment



- Industrial, Commercial, Multi-family, Arterials and Highways to: fish-bearing streams, lakes, or their tributaries
- Performance Goal: Greater dissolved metals removal
 - Reduce potential for WQ standards violations
- BMP Options - 4 BMPs; 7 BMP trains

Enhanced Treatment



- Not a nationwide response, other than reduce surface runoff volume
- King County response
 - Apply to all development in high quality resource streams
 - Doesn't comply with Clean Water Act

Enhanced Treatment Issues



- Is Enhanced Treatment necessary?
 - Is there enough information to support this requirement given the significant cost?
 - Should rural highways and arterials be included?
 - Should there be an Average Daily Trip threshold for roads?
 - Are acute WQ standards applicable and appropriate?
 - Does the guidance re which receiving waters to apply it to need adjustment?
- Is the list of BMP options appropriate?
 - Lack of performance data for BMPs makes judgements difficult

Minimum Requirement #7

Flow Control



- Purpose: To prevent increases in stream channel instability or erosion rates
- Presumptive Water Quality-Based Requirement
 - Local hydrogeologic basis

A black and white photograph of a narrow stream flowing through a dense forest. The stream is filled with rocks and debris, and its banks are covered in thick vegetation, including ferns and other plants. The trees are tall and slender, with their trunks visible in the background. The overall scene is a natural, wooded landscape.

**Easter Lk. Outlet,
Federal Way, WA**

Photo by Derek Booth, U of W

Standard Requirement



- Match discharge durations to pre-developed durations for the range of pre-developed rates from 50% of the 2-year peak flow up to the full 50-year peak flow
- Generic requirement until replaced by a watershed-specific standard with hydrogeologic justification

Stream Channel Erosion



- Stream erosion results from work performed on a channel while conveying high flows
- Work = hydraulic force over time
- Hydraulic force is a function of flow rate

$$\text{Work} = f\{Q\} \times \text{time}$$

Stream Channel Erosion



- Erosive work is the portion of total work which occurs at flowrates above a “threshold of movement” of channel sediments
- Gravel embedded streams = 50% of 2-year streamflow (Booth, 1993)

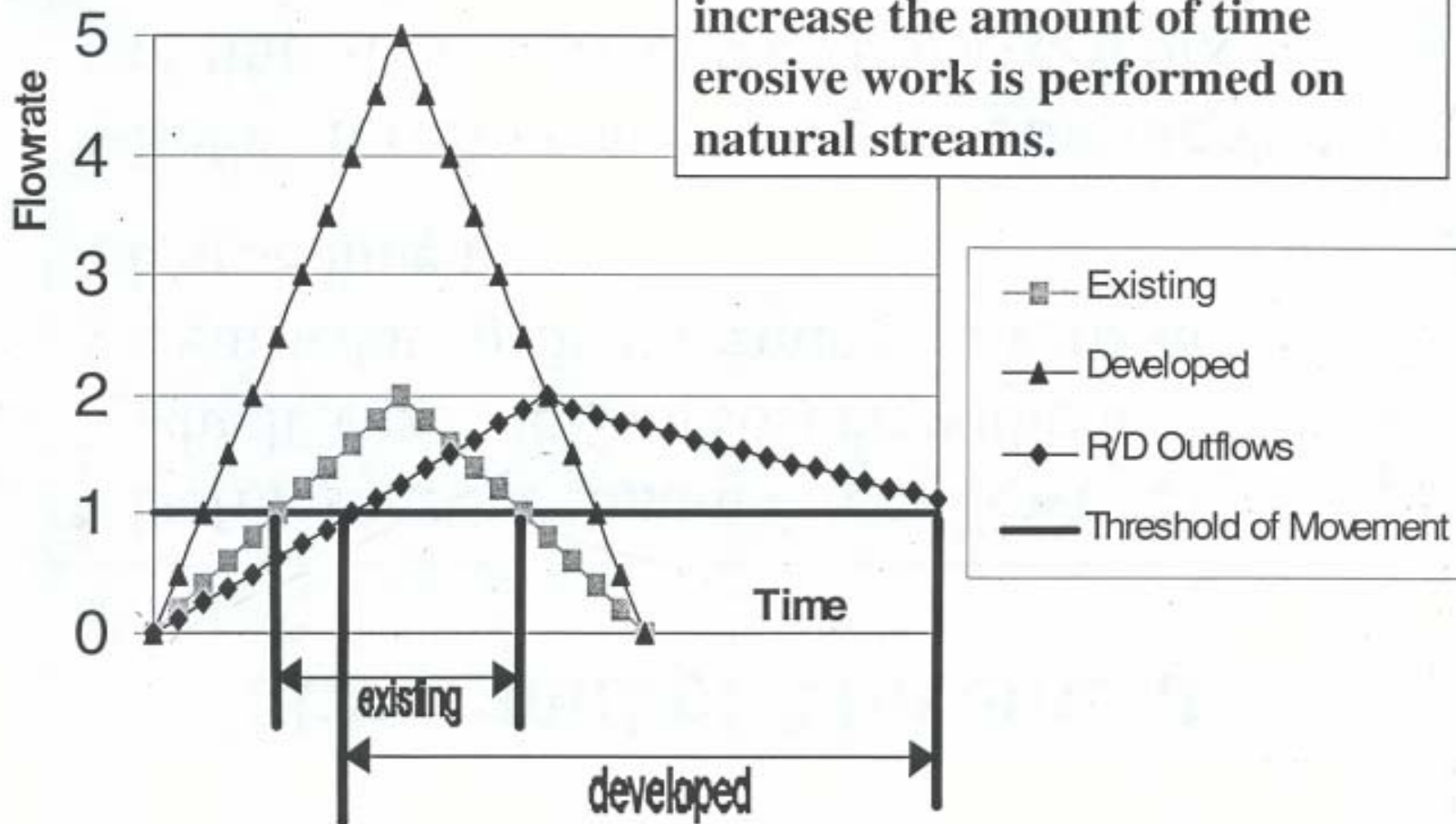
Threshold of Movement



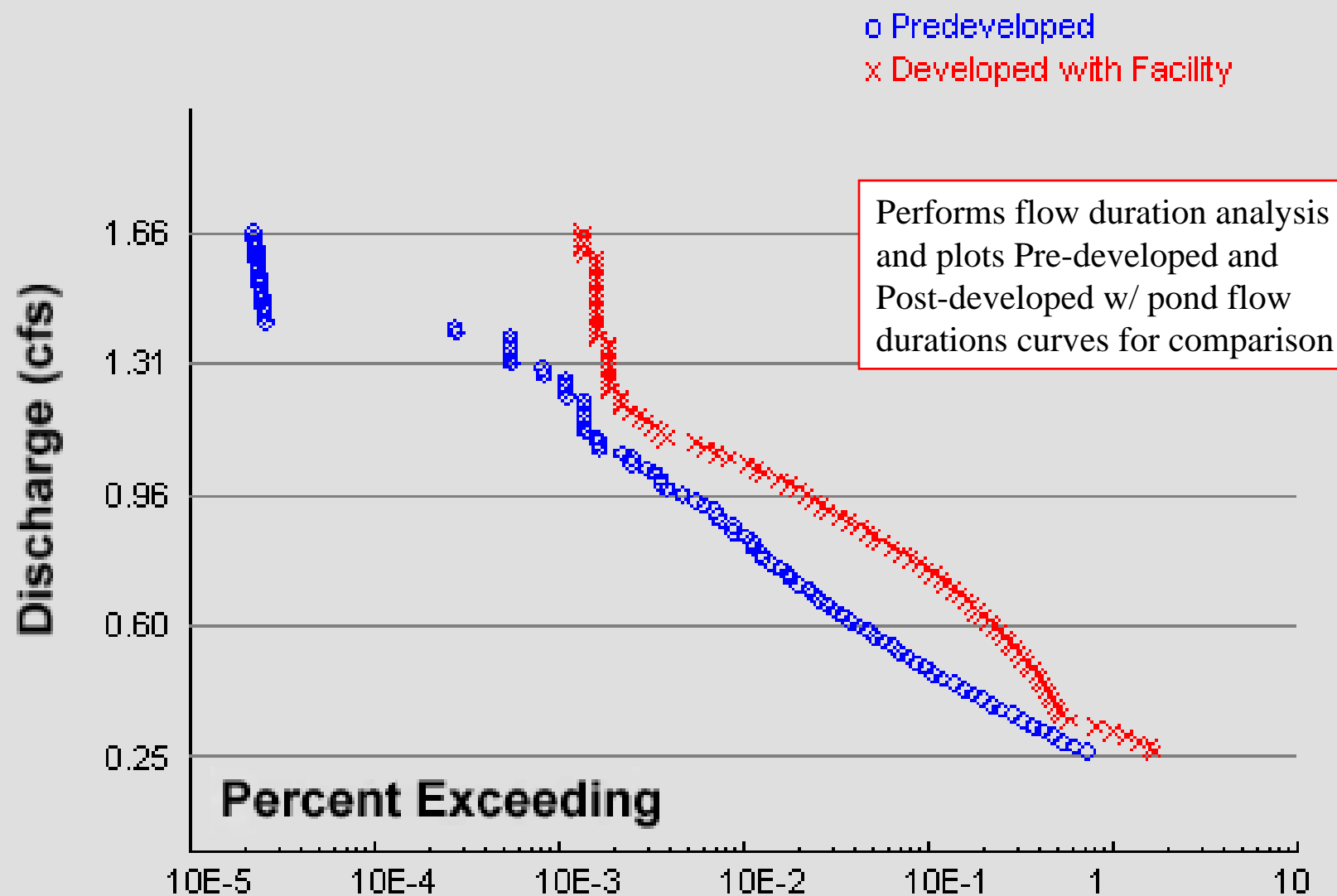
- Defines a maximum force (flow) which a channel can sustain w/o significant channel forming movement of bed sediments
- Below this flowrate, changes in the amount of time don't affect the “erosive work”

Conventional Detention

★ Conventional Detention may increase the amount of time erosive work is performed on natural streams.



File Graph



Title

Flow Control Assumptions



- **Threshold of significant bedload movement**
 - Protects most Puget Sound streams
 - Booth (1993)
- **Converting pre-development surface flows and interflows to surface flows**
- **Estimated flow rates not adjusted for site location in a watershed**
- **Assume forested pre-developed condition unless evidence otherwise**



Method for Compliance

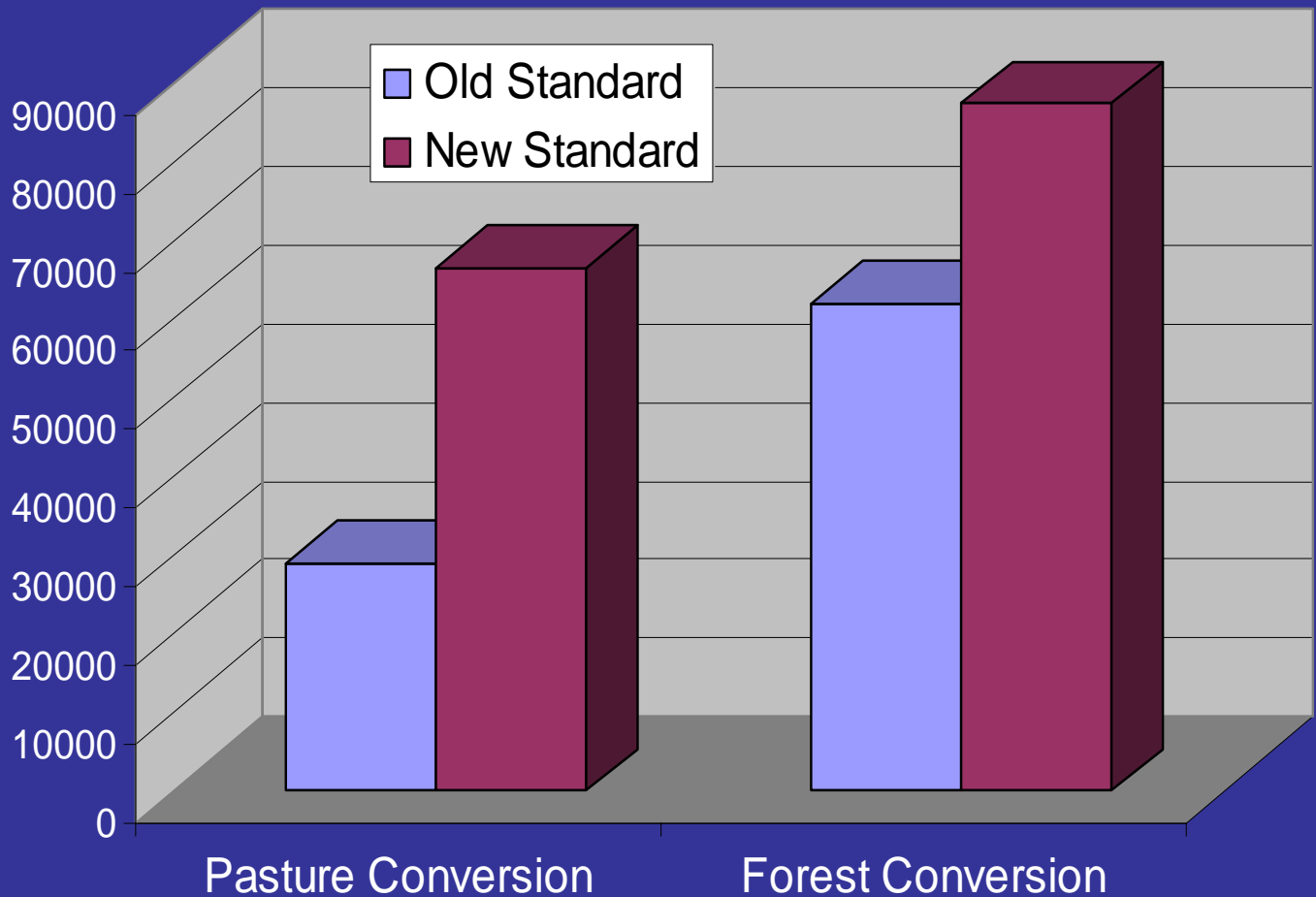
- Continuous Simulation Model
 - Hydrologic Simulation Program-Fortran (HSPF)
 - WWHM is an application of HSPF for Western Washington
- Download from website:
ecy.wa.gov/programs/wq/stormwater/wwhm_training

Western Washington Hydrology Model (WWHM)



- Uses Default calibrated parameters
 - Dinicola (1990)
 - King County, Thurston Co.
- Locally calibrated parameters and/or rainfall data may be used with Ecology concurrence

Detention Volume Comparison Old Standard Vs. New Standard



Flow Control

- Direct Discharge Exemption
 - Local government petitions/hydrologic basis



Flow Control Thresholds

Table 2.2 Flow Control Requirements by Threshold Discharge Area

	Flow Control Facilities	On-site Stormwater Management BMPs
< $\frac{3}{4}$ acres conversion to lawn/landscape, or < 2.5 acres to pasture		✓
$\geq \frac{3}{4}$ acres conversion to lawn/landscape, or ≥ 2.5 acres to pasture	✓	✓
< 10,000 square feet of effective impervious area		✓
$\geq 10,000$ square feet of effective impervious area	✓	✓
≥ 0.1 cubic feet per second increase in the 100-year flood frequency	✓	✓





Significant Issues & Limitations

Technology & Knowledge Limitations

- **New hydrology model**
 - better than single event, but still a model
- **Uncertainty with efficiency of treatment methods**
 - New treatment testing protocol
 - Coordinate w/ national efforts

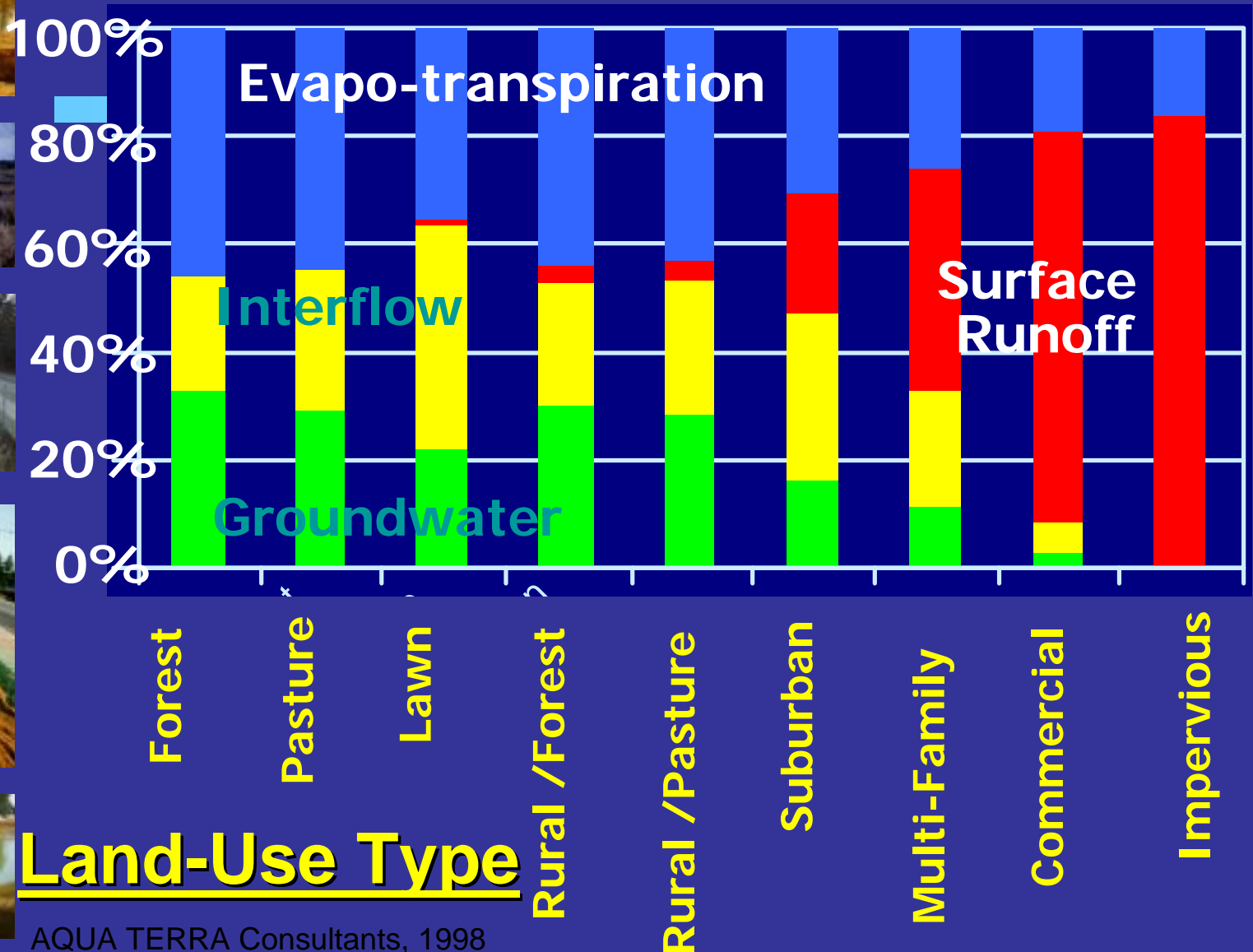


Approach and Scope

- **Presumptive approach – will not always be adequate**
 - Limited opportunity for case-by-case
 - Basin-specific requirements
 - e.g. Threshold of bedload movement
- **Project site level focus not considering cumulative watershed scale impacts**
- **Manual is a necessary but by itself insufficient tool to achieve “properly functioning conditions” for salmonids**



Where does the precipitation go ?



Limitations of Detention Facilities



- **Can't replicate the natural hydrology**
 - **Dominant flow regime changes**
 - Not matching all flow durations
 - **Less groundwater recharge**
 - Lower summer base flows
 - **Less evapotranspiration**
- **Resource Implications**

Limitations of Treatment Facilities

- Difficult/Can't meet WQ Standards
 - Bacteria
 - Solids/Turbidity (if fine soils)
 - Temperature
 - Toxicants
 - Organics - insecticides/herbicides, PAH's, phthalates
 - Metals – dissolved copper, zinc?



Impacts of Urbanization



- Shift in Watershed Hydrology
- Increased Pollutant loading
- Degradation of riparian buffers
- Stream Habitat Degradation
 - Loss of Habitat Complexity & Quality
 - Migration Barriers (culverts, dams, etc.)

Land Use Management



- **Disconnect pollutants and runoff from surface waters**



- **SW Manual should not drive land use**
 - Manual has a project level focus
 - Short of restricting site disturbance, what can be done to minimize impacts & protect resources



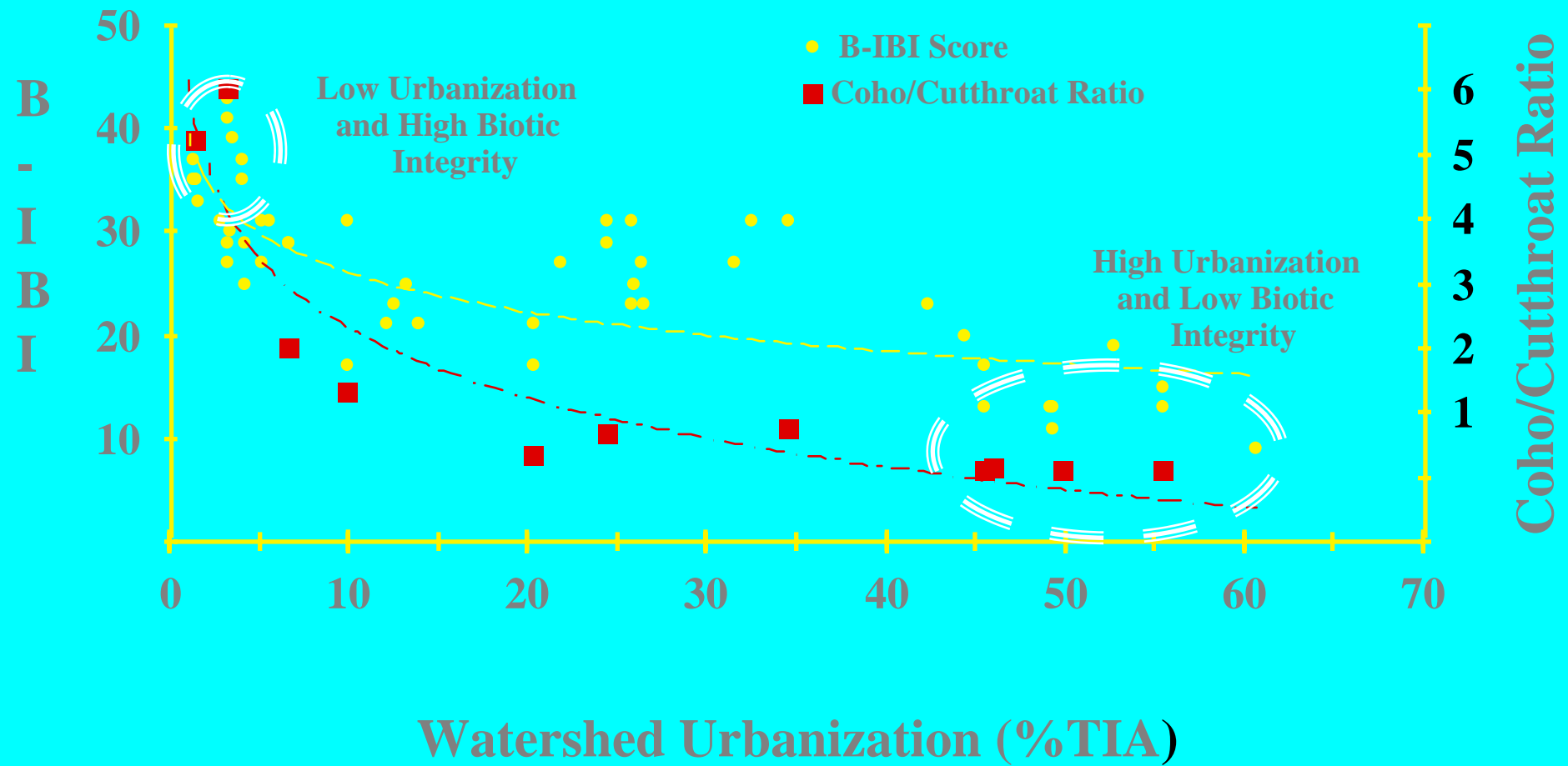
- **Growth Management Act**
 - Critical Areas Ordinances
 - Comprehensive Plans
 - Site Development Standards
 - LID = Standard Operating Procedure



Forest Cover & Stream Conditions



- **Unstable Stream Channels Predicted:**
 - 4% Effective Impervious Area (1 home/5 acres) with < 45% mature forest cover
- **Stable Stream Channels Predicted:**
 - 4% Effective Impervious Area with > 70% mature forest cover
 - More forest cover may be necessary for soils with higher infiltration rates than till soils



Need Both Tools

- **Land Use Management**
 - Primary tool to protect natural resources
 - Preserve vegetative & soil cover
 - Low Impact Development (LID) will reduce cost of stormwater management
- **Stormwater Manual**
 - To manage remaining surface runoff until Zero Impact Development
 - To encourage use of LID



Manual & Land Use Overlap



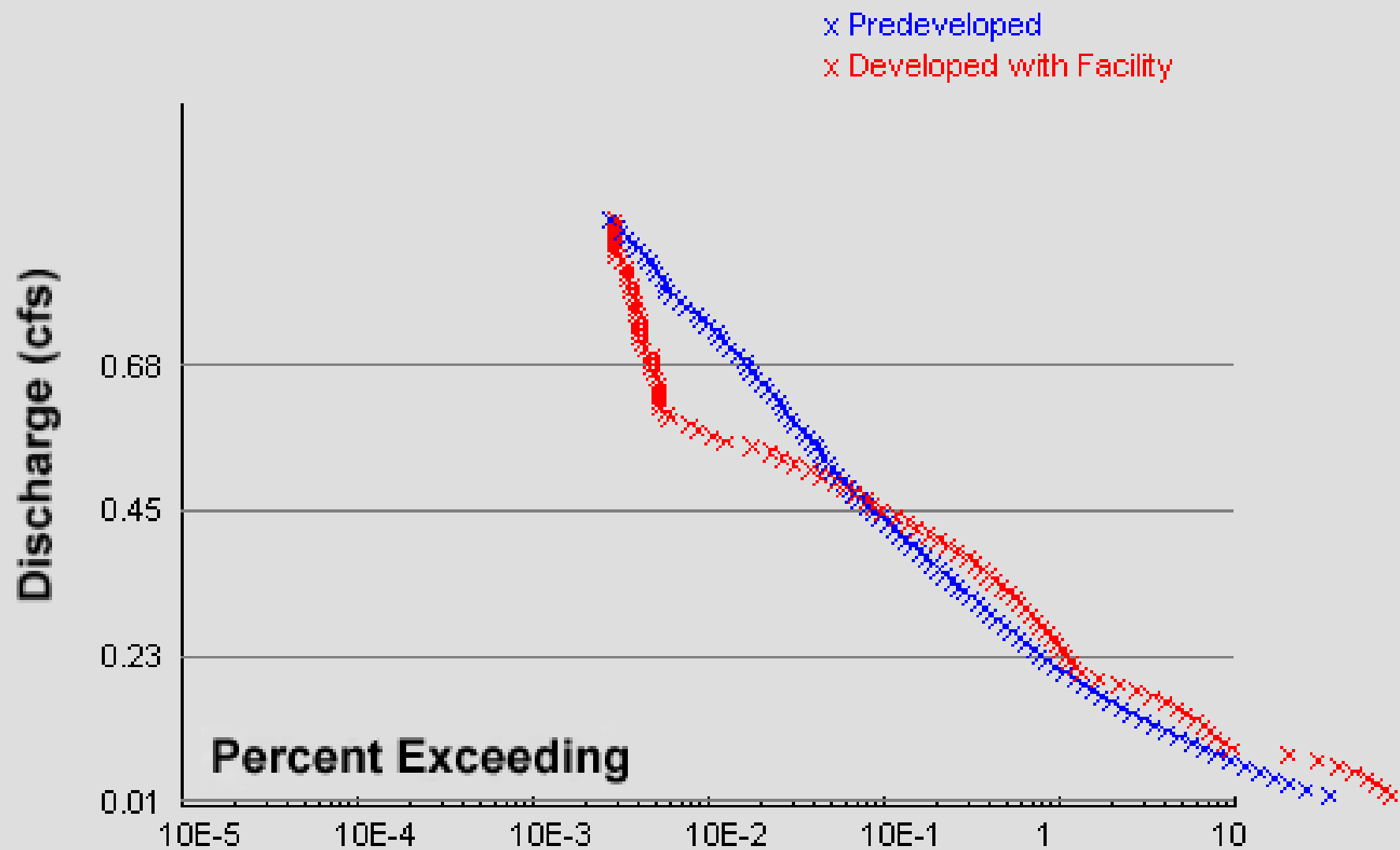
- **Post Construction Soil Quality & Depth BMP**
 - Minimum organic content, pH, depth
 - For landscaped and turf areas
 - Restore some soil & hydrologic functions
 - Pollutant source control

Manual Incentives to LID



- Protected areas with natural vegetation and soils aren't modeled
- Credits for LID techniques
 - Balance Risks
 - Over-estimate benefit versus discouraging change

File Graph



Title

Cost Controversy

- **Cost of the new requirements**
 - Flow Control
 - Enhanced Treatment
 - On-Site Management BMPs
- **Cost analysis:**
 - Compare 1992 versus 2001 manuals
 - Ecology webpage
 - <http://www.ecy.wa.gov/programs/wq/stormwater/manual.html#costs>





General Questions



Implementation

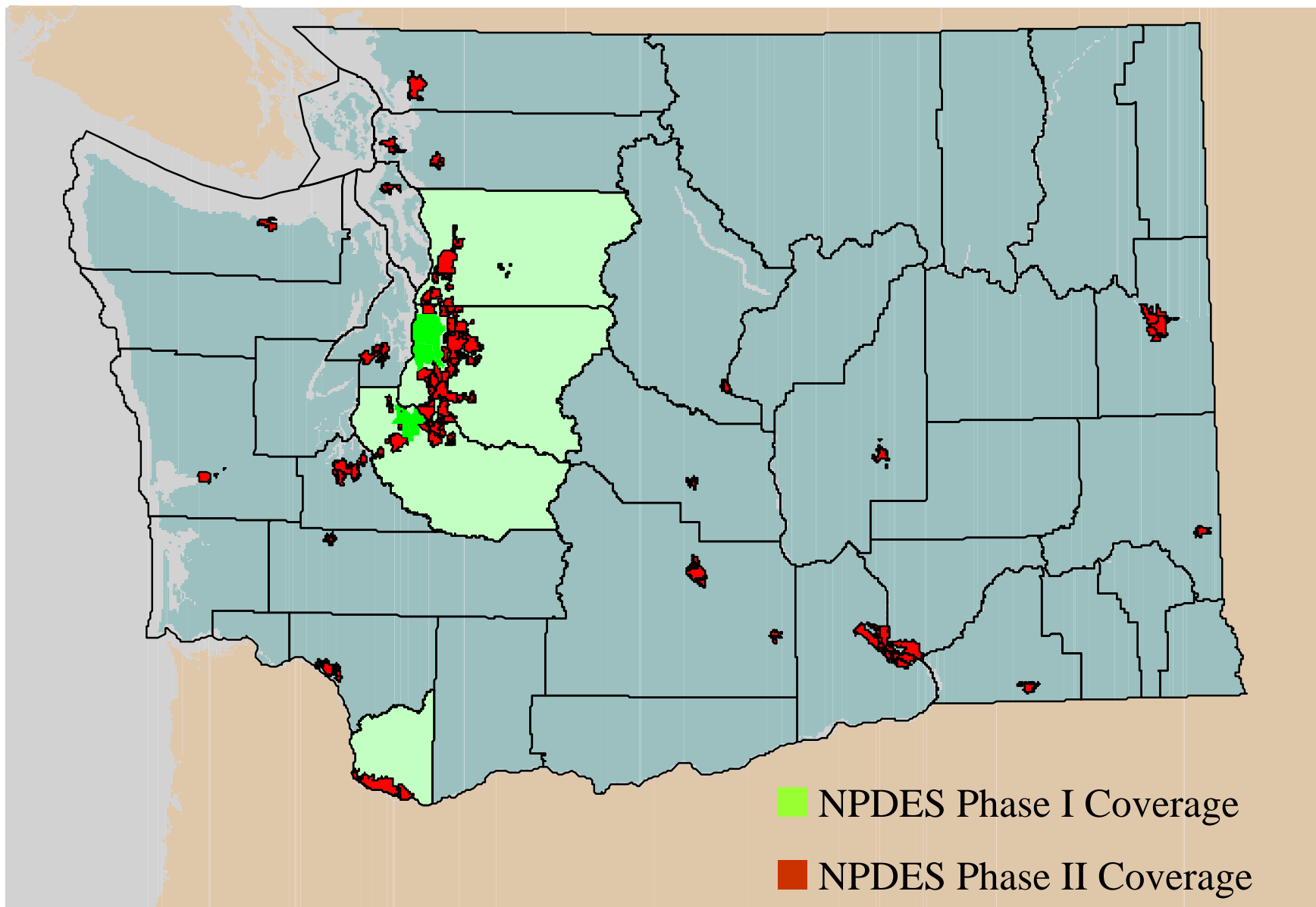
- Local Ordinances/Rules/Manuals
- State Permits
 - NPDES
 - Fish & Wildlife HPA's
 - Section 401 WQ Certifications
- Federal Permits
 - COE Section 404
- Federal Opinions
 - ESA Implementation



Who Needs It?

- **Puget Sound Communities**
 - Adopt or an Equivalent by 3/2003
- **NPDES Phase I**
 - Permit Condition
- **NPDES Phase II**
 - Regionally Appropriate Guidance
 - Western Washington Permit?







Who Needs It?

- **Outside P.S. & Not NPDES**
 - Where SW is a limiting factor (Governor's Salmon Strategy)
 - Elsewhere, guidance

Manual Equivalency Criteria

Page 1-9



- **Minimum Requirements (bolded font)**
- **Thresholds and Definitions**
- **BMP Selection and Site Planning Processes**
- **Types of BMPs and Design Criteria**
- **Adjustments & Variances (bolded font)**

Redevelopment Threshold Summary



New impervious or Converted Pervious

– Same as “New Development”

- Replaced impervious surfaces
 - ⇒ Treatment and Flow Control only if
 - New + replaced impervious $\geq 5,000$ sq. ft., and Proposed improvements value $> 50\%$ of existing improvements value
 - For roads, new impervious $\geq 5,000$ sq. ft., and $\geq 50\%$ of existing impervious area

Redevelopment Scope

- **Existing Surfaces That Aren't Replaced**
 - Only addressed if runoff not separated
 - Treatment facilities must be sized for flows that they receive
 - Flow Control facilities have a limit on “offsite inflow” that can be accepted



Redevelopment Exemption



- **Replaced Impervious Surfaces**
 - If Plan and Schedule for Regional Facilities
- **New Impervious surfaces are not exempted.**
 - Regional facilities should be on-line or imminent.

Alternative Mitigation for Redevelopment Sites



- Equivalent Area within Site
- For Roads, Equivalent Area must drain to same receiving water
- Supplemental Guidelines
 - Fee-in-lieu

Minimum Requirement #1

Stormwater Site Plan Preparation

- Over 2,000/7,000: Submit for local government review
- Stormwater Site Plan
 - Prepare a Permanent Stormwater Quality Control Plan
 - Prepare a Construction Stormwater Pollution Prevention Plan



Minimum Requirement #2

Construction Stormwater Pollution Prevention

- Construction SWPPP - local government review
 - 2,000 sf of impervious surface (new & replaced total)
 - or disturb 7,000 square feet of land
- All 12 elements considered and included in SWPPP
 - unless unnecessary and clearly justified in the narrative



Minimum Requirement #2

Construction Stormwater Pollution Prevention

- **Small projects < 2,000/7,000**
 - consider 12 Elements and develop controls for all pertinent elements
 - **No SWPPP submittal**
 - **Suggested Implementation**
 - **Instructions with Building Permit**



The 12 Elements are



- Mark Clearing Limits
- Establish Construction Access
- Control Flow Rates
- Install Sediment Controls
- Stabilize Soils
- Protect Slopes
- Protect Drain Inlets
- Stabilize Channels And Outlets
- Control Pollutants
- Control De-Watering
- Maintain BMPs
- Manage the Project

Minimum Requirement #2

Significant Changes

- **Element #4 – Sediment Controls**
 - Retain natural vegetation consistent with development plan
- **Element #11 - Sediment control BMP inspections**
 - Dry season – weekly & after events
 - Wet season - daily



Minimum Requirement #2

Significant Changes



- **Element #12 - Project Management**
 - Phase construction where feasible
 - Seasonal work limitations between October 1 and April 30
 - Inspection and Monitoring, including a Certified Erosion Control Professional
 - Maintenance of the Construction SWPP

VOLUME II

Construction Stormwater Pollution Prevention (Minimum Requirement #2)



Volume II

Construction SWPPP

- Objective – Avoid adverse impacts on downstream resources & on-site facilities
- Organization
 - Ch. 1 – Intro. and Background
 - Ch. 2 – Relationship to P.S. Plan, NPDES, WQ Standards, ESA, Other
 - Ch. 3 – How to develop a Construction SWPPP
 - Ch. 4 – BMPs



Chapter 3 – Planning

- **Step-by-Step Procedure**
 - Data Collection
 - Data Analysis
 - Construction SWPPP
Development & Implementation
 - Lists Elements & BMPs to achieve
 - Construction SWPPP Checklists
 - For Narrative & Drawings



Significant Changes to Volume II



- **Construction SWPPP Checklist**
- **Technical edits to the BMPs in Chapter 4**
 - e.g., Straw Bales not to be used in ditches
- **New BMPs**
 - Materials on Hand - page 4-42
 - Concrete Handling - page 4-43
 - Sawcutting and Surfacing -page 4-44

Significant Changes to Volume II

- **New BMPs**
 - **Payment of Erosion Control Work**
page 4-47
 - **Small Project Construction SWPP**
page 4-50
 - **Contractor Erosion and Spill
Control Lead** page 4-45
 - **Straw Wattles**
page 4-95



Minimum Requirement #3

Source Control



- Prevention is still best strategy
- Requires Source Control BMPs for areas and activities described in Chapter 2 of Volume IV
- Applies primarily to Commercial/Industrial

What is the Problem?



Minimum Requirement #4

Preservation of Natural Drainage Systems and Outfalls



- **Maintain natural drainage patterns**
- **Discharge at the natural location**
- **No adverse impact to receiving waters and properties.**
 - See Supplemental Guidelines
- **Outfall energy dissipation.**



Minimum Requirement #5

On-Site Stormwater Management



- **Intent: reduce hydrologic change**
- **Apply on-site BMPs to infiltrate, disperse, and retain runoff**
- **Applies primarily to Residential Areas**



Minimum Requirement #8

Wetlands Protection



- Thresholds same as M.R. #6 and #7
- Apply treatment BMP
- Maintain hydrologic conditions, vegetation, substrate – requires continuous runoff model
- Use Puget Sound Wetlands Research Program as amended in Appendix I-D
- Facilities not in natural buffer

Minimum Requirement #9

Basin/Watershed Planning

- Local Government Option
- Equivalent or more stringent requirements for erosion control, source control, treatment, O&M
- Alternative flow control, wetlands protection requirements, (Enhanced)
- Clean Water Act consistency/State agrees
- Appendix I-A examples



Minimum Requirement #10

Operation and Maintenance

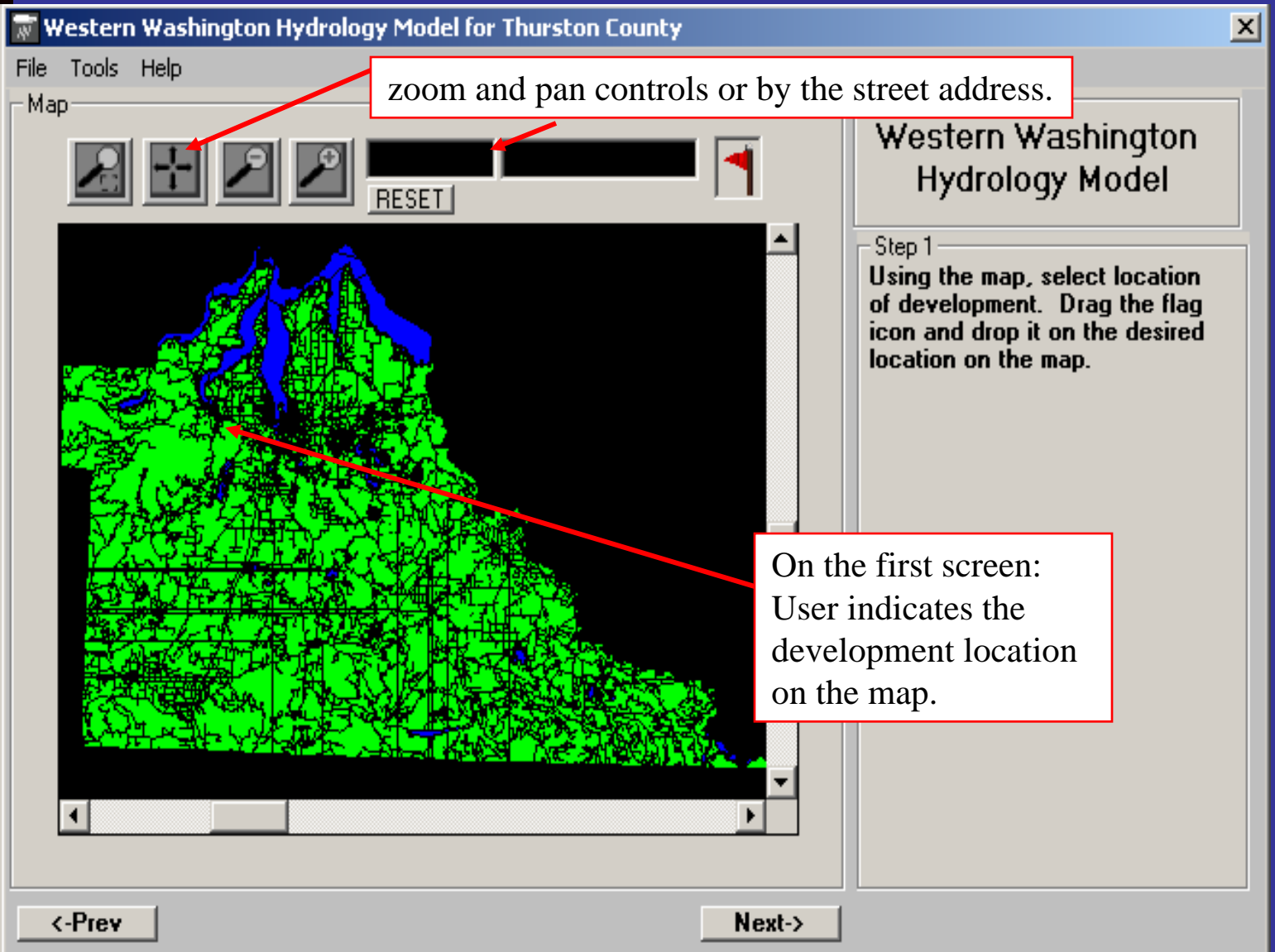
- O&M manual for all facilities
- Responsible parties identified
- Local governments adopt equivalent O&M standards
 - Volume V, Section 4.6
- Manual readily available



Western Washington Hydrology Model (WWHM)



- Based on EPA's Hydrological Simulation Program - Fortran (HSPF)
- Includes Graphic and Menu Screens to facilitate:
 - Data entry; Program Execution; Output Analysis; and Design Reviews



Enter the number of acres for each type of soil before development.

Enter the development name and address here.

Western Washington Hydrology Model for Thurston County

File Tools Help

Name of Development: name

Development Address: address

City / County: city

Project Description

WDM Time Series Data Type

Standard Residential ☒

Non-standard / Commercial ☐

Predeveloped Acres

Outwash A&B	5
Till C/D	10
Saturated	0
Total Acres	15

Predeveloped Vegetation

☒ Forest ☐ Pasture

Basins

☒ Design Basin ☐ Bypass ☐ Offsite Inflow

Estimated Pond Area

Outwash A&B	0
Till C	1

Residential Acres

	A/B soils	C/D soils
Lot Acres	0	6
Streets/Sidewalks	3	2
Forest	0	0
Pasture	0	0
Landscaped Area	2	1
Number of Lots	40	

Pavement Credit

Porous Pavement ☒

Percentage 65 %

Roof Runoff Credits

INFILTRATE	<input checked="" type="checkbox"/>	30 %
DISPERSE	<input checked="" type="checkbox"/>	40 %

Western Washington Hydrology Model

Step 2

Fill in site information and list acres for each type of development.

<-Prev

Next->

You can then apply any appropriate credit for infiltrating or dispersing roof runoff or for using Porous Pavement

Run the model.

WWHM Summary Report



- Site Information Summary:
 - Name; Address; Soils; Development Type; Acres
- Detention Pond Design:
 - Stage/Storage Discharge Table
- Compares Runoff Statistics:
 - Pre- Developed & Post-Developed
- Determines Compliance

Volume IV

Source Control BMPs (Minimum Requirement #3)



Source Control BMPs

- **Applicable BMPs – Section 1.6**
 - **BMPs for equivalency**
 - **BMPs likely referenced in the reissued NPDES Industrial Stormwater General Permit**



Source Control BMPs

- Recommended BMPs –Section 1.6
 - Approaches beyond or complementary to the applicable BMPs
 - Not necessary for manual equivalency & not likely required in NPDES permit



Operational Source Control BMPs



- **Section 1.4 Definition:**
 - Non-structural practices that prevent or reduce pollutants
- **Categories**
 - Preventive Maintenance
 - Employee Training
 - Inspections
 - Record Keeping
 - P2 Team
 - Good Housekeeping
 - Spill Prevention & Clean-up

Operational Source Control BMPs



- Section 2.1 lists applicable and recommended BMPs for each category; e.g.
 - Good Housekeeping
 - Sweeping
 - Clean oils, debris, sludge regularly
- These apply to all types of industrial/commercial sites

Structural Source Control BMPs



- Physical, structural, or mechanical devices or facilities to prevent pollutants from entering stormwater
- Examples
 - Enclosing/covering (Building, Roof, lean-to) to prevent runoff
 - Stormwater segregation to prevent runoff
 - Direct Contaminated Stormwater to treatment

Section 2.2 Pollutant Source-Specific BMPs



- **31 different areas/activities listed**
 - Commercial Composting
 - Fueling
 - Etc.
- **For Each Area/Activity**
 - Description of Pollutant Sources
 - Pollutant Control Approach
 - Applicable operational, structural, treatment BMPs
 - Recommended BMPs

VOLUME V

Runoff Treatment BMPs (Minimum Requirements #5, #6, #8, #10)



Runoff Treatment BMPs

- **Purpose**

Reduce Pollutants Using Physical, Biological & Chemical Removal Mechanisms so that beneficial uses are maintained and, where applicable, restored.



Volume V

Runoff Treatment BMPs



- **Chapter 1 - Introduction**
- **Chapter 2 - Treatment Facility Selection Process**
- **Chapter 3 – Treatment Facility Menus**
- **Chapter 4 – General Requirements**
- **Chapter 5 – On-site Stormwater Management**